36. A method for controlling a camless valve assembly in ~~an~~ engine, said engine having an engine cylinder, said valve assembly having a valve communicating with said cylinder, said method comprising:

opening said valve of said camless valve assembly at a first opening rate to control gas flow into said cylinder during a first combustion cycle of said cylinder; and,

opening said valve of said camless valve assembly at a second opening rate to control gas flow into said cylinder during a second combustion cycle of said cylinder.

REMARKS

I. INTRODUCTION

Applicant wants to thank the Examiner for their careful consideration of the subject application. Applicant has amended independent claims 1, 13, 14, 17, cancelled claim 18, and added new claims 23-36. Claims 1-17 and 23-36 are presently pending in the application. Applicant hereby requests further examination and reconsideration of the application in view of the foregoing amendments and the following arguments.

II. REJECTION OF CLAIMS 1, 2, 4, 13, 15, 16 UNDER 35 U.S.C. 102(b)

Claims 1, 2, 4, 13, 15, 16 stand rejected under 35 U.S.C. 102(b) as being anticipated by Beblavi (4,452,423). Applicant respectfully submits that the rejection of claims 1, 2, 4, 13, 15, 16 is improper because the reference does not disclose all the limitations of claims 1, 2, 4, 13, 15, 16, as amended.

Referring to claim 1, the claim recites an electromechanical valve assembly. The assembly includes a "valve stem configured to move upwardly when said rotor rotates in a first direction to move said valve head against a

valve seat in said engine to prevent gas flow into or out of said engine cylinder."

Referring to Beblavi, the reference describes a magnetically actuated valve that controls fluid flow through a "pipe." See column 2, lines 40-43. However, Beblavi clearly does not teach a valve assembly that moves a valve head against a valve seat in the engine to prevent gas flow into or out of an engine cylinder, as recited in amended claim 1. Accordingly, Applicant submits that the rejection of claim 1, as amended, and dependent claims 2, 4, under 35 U.S.C. 102(b) is improper.

Similarly, referring to independent claim 13, as amended, the claim recites an electromechanical assembly having a valve wherein "said valve moves axially responsive to rotation of said rotor to move said valve head against a valve seat in said engine to prevent gas flow into or out of an engine cylinder. Because Beblavi does not teach the foregoing limitation, Applicant submits that the rejection of claim 13, as amended, is also improper.

Similarly, referring to independent claim 15, the claim recites an engine having an electromechanical valve assembly including a first valve. The first valve is "configured to move generally axially responsive to the rotation of said first rotor to control an amount of gases communicating between said line and said cylinder. Because Beblavi does not teach the foregoing limitation, Applicant submits that the rejection of independent claim 15 and claim 16 (which depends from claim 15) is also improper.

As discussed above, because Beblavi does not teach a system having all of the limitations of claims 1, 2, 4, 13, 15, 16, Applicant submits that the rejection of the claims under 35 U.S.C. 102(b) is improper. Accordingly, Applicant respectfully requests that the rejection of claims 1, 2, 4, 13, 15, 16, under 35 U.S.C. 102(b) be withdrawn.

III. REJECTION OF CLAIM 14 UNDER 35 U.S.C. 102(b)

Independent claim 14 stands rejected under 35 U.S.C. 102(b) as being anticipated by Lund (4,097,786). Applicant respectfully submits that the rejection of claim 14 is improper because Lund does not disclose all the limitations of claim 14.

Referring to claim 14, the claim recites a electromechanical valve assembly having a valve. The valve includes a "valve stem configured to move generally axially responsive to the rotation of said ballnut to selectively engage and disengage said valve head with a valve seat on a cylinder head of said engine."

Referring to Lund, a ballscrew type actuator is disclosed. Referring to Figure 1 of Lund, the actuator is utilized to control a valve 5 which controls fluid flow though a pipe. However, Lund provides no teaching of utilizing such an actuator to engage and disengage a valve head with a valve seat on a cylinder head of an engine, as recited in claim 14.

Because Lund does not teach a system having all of the limitations of claim 14, Applicant submits that the rejection of claim 14 under 35 U.S.C. 102(b) is improper. Accordingly, Applicant respectfully requests that the rejection of claim 14 under 35 U.S.C. 102(b) be withdrawn.

IV. REJECTION OF CLAIM 17 UNDER 35 U.S.C. 102(b)

Independent claim 17 stands rejected under 35 U.S.C. 102(b) as being anticipated by Miyoshi (5,983,847). Applicant respectfully submits that the rejection of claim 17 is improper because Miyoshi does not disclose all the limitations of claim 17.

Referring to amended claim 17, the claim recites a control system for a linear actuated electromechanical valve assembly having a valve controller. The valve controller in conjunction with the valve assembly can vary an "opening rate" and a "closing rate" of a valve. A valve opening rate is an

amount of valve lift over a time period when the valve is being opened, as illustrated in Figure 7 of the application. As illustrated, Figure 7 shows a first opening rate OR1 and a different and faster than an opening rate OR2, for example. Similarly, a valve closing rate is an amount of valve lift over a time period when the valve is being closed. As illustrated, Figure 7 shows a first closing rate CR1 and a different and slower closing rate CR2.

Referring to Miyoshi, an electric valve drive device is described for controlling a valve 3. Referring to Figure 3, various valve lift profiles are illustrated which illustrate the device can adjust a valve lift of valve 3. Miyoshi, however, provides no teaching of a controller that can adjust the opening rate and closing rate of a valve, as recited in amended claim 17.

Because Miyoshi does not teach a system having all of the limitations of claim 17, Applicant submits that the rejection of claim 17 under 35 U.S.C. 102(b) is improper. Accordingly, Applicant respectfully requests that the rejection of claim 17 under 35 U.S.C. 102(b) be withdrawn.

V. REJECTION OF CLAIM 3 UNDER 35 U.S.C. 103(a)

Dependent claim 3 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Beblavi in view of Lindner (5,832,944). Applicant respectfully submits that the rejection of claim 3 is improper because the Examiner has failed to make a prima facie case of obviousness.

Applicant submits that neither reference provides any motivation for the proposed combination. Referring to Beblavi, the invention is directed to a valve assembly that simply controls fluid flow through a "pipe." Similarly, Lindner is also only directed to controlling fluid flow through a "pipe." Neither reference is directed toward controlling fluid communication of an air/fuel mixture with an engine cylinder. Thus, there is simply no motivation in either

reference for combining the references to obtain a valve assembly for controlling fluid communication with an engine cylinder. Accordingly, Applicant submits that the rejection of claim 3 is improper.

Further, even if the teachings of Beblavi and Lindner were combined, the proposed combination would fail to operate in an engine. Referring to Beblavi, the reference teaches that to prevent fluid flow through a pipe, either a ballnut 47 or a valve stem 46 is rotated in a "clockwise" direction to move a valve downwardly to seal against a seal. Similarly, Lindner rotates a ballnut in a clockwise direction to seal a valve against a valve seat. However, referring to Figure 3 of the present application, it is clear, that rotating the ballnut in a clockwise direction would only move the valve head further away from the valve seal. Thus, the combined teaching of Beblavi and Lindner would not allow the valve head to seal against a valve seal as required for combusting an air/fuel mixture in the engine cylinder. In other words, the combined teachings would result in an inoperable internal combustion engine.

Still further, the proposed combination of Beblavi and Lindner does not teach or suggest all of the limitations of dependent claim 3. Dependent claim 3 includes all of the limitations of independent claim 1 from which it depends. As discussed above, claim 1 recites an electromechanical valve assembly having a valve "configured to move upwardly when said rotor rotates in a first direction to move said valve head against a valve seat in said engine to prevent gas flow into or out of said engine cylinder." However, neither reference teaches controlling gas flow into or out of an "engine cylinder" as recited in claim 1 and dependent claim 3.

Because the proposed combination fails to teach or suggest all of the limitations of dependent claim 3, Applicant submits that the rejection of claim 3 under 35 U.S.C. 103(a)

is improper. Accordingly, Applicant requests that the rejection of claim 3 be withdrawn.

VI. REJECTION OF CLAIM 5 UNDER 35 U.S.C. 103(a)

Dependent claim 5 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Beblavi in view of Lange (5,485,760). Applicant respectfully submits that the rejection of claim 5 is improper because the Examiner has failed to make a prima facie case of obviousness.

Applicant submits that neither reference provides any motivation for the proposed combination. As discussed above in Section V, Beblavi is only directed toward controlling flow through a "pipe." Further, Lange is merely directed toward the ball nut and screw assembly and is not directed toward any engine application. Thus, there is simply no motivation provided in either reference for combining the references to obtain a valve assembly for controlling fluid communication with an engine cylinder. Accordingly, Applicant submits that the rejection of claim 5 is improper.

Further, even if the teachings of Beblavi were combined with Lange, the combined teachings would not work in an internal combustion engine. As discussed above in Section V, Beblavi teaches that to prevent fluid flow through a pipe, either a ballnut 47 or a valve stem 46 is rotated in a "clockwise" direction to move a valve downwardly to seal against a seal. Referring to Figure 3 of the present application, it is clear however that rotating the ballnut in a clockwise direction would only move the valve head further away from the valve seal. Thus, the combined teachings of Beblavi and Lange would not allow the valve head to seal against a valve seal for combusting an air/fuel mixture in the engine cylinder. In other words, the combined teachings would result in an inoperable internal combustion engine.

Still further, the proposed combination of Beblavi and Lange does not teach or suggest all of the limitations of

dependent claim 5. Dependent claim 5 includes all of the limitations of independent claim 1 from which it depends. As discussed, Beblavi does not teach controlling gas flow into or out of an "engine cylinder" as recited in claim 1 and dependent claim 5. Similarly, Lange does not teach the recited limitation.

Because the proposed combination fails to teach or suggest all of the limitations of dependent claim 5, Applicant submits that the rejection of claim 5 under 35 U.S.C. 103(a) is improper. Accordingly, Applicant requests that the rejection of claim 5 be withdrawn.

VII. REJECTION OF CLAIM 6 UNDER 35 U.S.C. 103(a)

Dependent claim 6 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Beblavi in view of Reinicke (5,318,064). Applicant respectfully submits that the rejection of claim 6 is improper because the Examiner has failed to make a prima facie case of obviousness.

Applicant submits that neither reference provides any motivation for the proposed combination. As discussed above in Section V, Beblavi is only directed toward controlling flow through a "pipe." Similarly, Reinicke is only directed toward controlling flow through a pipe. Thus, there is simply no motivation provided in either reference for combining the references to obtain a valve assembly for controlling fluid communication with an engine cylinder. Accordingly, Applicant submits that the rejection of claim 6 is improper.

Further, even if the teachings of Beblavi were combined with Reinicke, the combined teachings would not work in an internal combustion engine. As discussed above in Section V, Beblavi teaches that to prevent fluid flow through a pipe, either a ballnut 47 or a valve stem 46 is rotated in a "clockwise" direction to move a valve downwardly to seal against a seal. The system of Reinicke operates in a similar manner. Referring to Figure 3 of the present application,

however, it is clear that rotating the ballnut in a clockwise direction would only move the valve head further away from the valve seal. Thus, the combined teaching of Beblavi and Reinicke would not allow the valve head to seal against a valve seal for combusting an air/fuel mixture in the engine cylinder. In other words, the combined teachings would result in an inoperable internal combustion engine.

Still further, the proposed combination of Beblavi and Reinicke does not teach or suggest all of the limitations of dependent claim 6. Dependent claim 6 includes all of the limitations of independent claim 1 from which it depends. As discussed above, Beblavi does not teach controlling gas flow into or out of an "engine cylinder" as recited in claim 1 and dependent claim 6. Similarly, Reinicke also fails to teach the limitation. Because, the proposed combination fails to teach or suggest all if the limitations of dependent claim 6, Applicant submits that the rejection of claim 6 under 35 U.S.C. 103(a) is improper. Accordingly, Applicant requests that the rejection of claim 6 be withdrawn.

VIII. REJECTION OF CLAIM 9 UNDER 35 U.S.C. 103(a)

Dependent claim 9 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Beblavi in view of Feucht (5,606,957). Applicant respectfully submits that the rejection of dependent claim 9 is improper because the Examiner has failed to make a prima facie case of obviousness.

Applicant respectfully submits that no proper motivation exists for the proposed combination. However, even if the combination were made, the combined teachings of Beblavi and Feucht result in an inoperable internal combustion engine. As discussed above in Section V, Beblavi teaches that to prevent fluid flow through a pipe, either a ballnut 47 or a valve stem 46 is rotated in a "clockwise" direction to move a valve downwardly to seal against a seal. The system of Feucht operates in a similar manner. Referring to Figure 3 of the

present application, however, it is clear that rotating the ballnut in a clockwise direction would only move the valve head further away from the valve seal. Thus, the combined teachings of Beblavi and Feucht would not allow the valve head to seal against a valve seal for combusting an air/fuel mixture in the engine cylinder. In other words, the combined teachings would result in an inoperable internal combustion engine.

Still further, the proposed combination of Beblavi and Feucht does not teach or suggest all of the limitations of dependent claim 9. Dependent claim 9 includes all of the limitations of independent claim 1 from which it depends. As discussed above, Beblavi does not teach controlling gas flow into or out of an "engine cylinder" as recited in claim 1 and dependent claim 9. Feucht also fails to teach the limitation. Because, the proposed combination fails to teach or suggest all of the limitations of dependent claim 9, Applicant submits that the rejection of claim 9 under 35 U.S.C. 103(a) is improper. Accordingly, Applicant requests that the rejection of claim 9 be withdrawn.

IX. REJECTION OF CLAIM 10 UNDER 35 U.S.C. 103(a)

Dependent claim 10 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Beblavi in view of Ackerman (6,109,589). Applicant respectfully submits that the rejection of dependent claim 10 is improper because the Examiner has failed to make a prima facie case of obviousness.

Applicant submits that neither reference provides any motivation for the proposed combination. As discussed above in Section V, Beblavi is only directed toward controlling flow through a "pipe." Further, the Examiner indicated that Ackerman teaches use of a position sensor for determining a rotational position of a rotor. However, there is no motivation provided in either reference for combining the references to obtain a valve assembly for controlling gas flow

into or out of said engine cylinder. Accordingly, Applicant submits that the rejection of claim 10 is improper.

Even if the combination were made, the combined teachings of Beblavi and Ackerman result in an inoperable internal combustion engine. As discussed above in Section V, Beblavi teaches that to prevent fluid flow through a pipe, either a ballnut 47 or a valve stem 46 is rotated in a "clockwise" direction to move a valve downwardly to seal against a seal. Referring to Figure 3 of the present application, however, it is clear that rotating the ballnut in a clockwise direction would only move the valve head further away from the valve seal. Thus, the combined teachings of Beblavi and Ackerman would not allow the valve head to seal against a valve seal for combusting an air/fuel mixture in the engine cylinder. In other words, the combined teachings would result in an inoperable internal combustion engine.

Still further, the proposed combination of Beblavi and Ackerman does not teach or suggest all of the limitations of dependent claim 10. Dependent claim 10 includes all of the limitations of independent claim 1 from which it depends. As discussed above, Beblavi does not teach a electromechanical valve assembly with a valve "configured to move upwardly when said rotor rotates in a first direction to move said valve head against a valve seat in said engine to prevent gas flow into or out of said engine cylinder", as recited in claim 1 and dependent claim 10. Ackerman also fails to teach the foregoing limitations. Because, the proposed combination fails to teach or suggest all if the limitations of dependent claim 10, Applicant submits that the rejection of claim 10 under 35 U.S.C. 103(a) is improper. Accordingly, Applicant requests that the rejection of claim 10 be withdrawn.

X. REJECTION OF CLAIM 18 UNDER 35 U.S.C. 103(a)

Dependent claim 18 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Miyoshi (5,983847) in view of Bonvallet (4,777,915). Applicant has cancelled claim 18.

XI. NEW CLAIM 23

New independent claim 23 recites a valve assembly having a valve that moves a "valve head against a valve seat in said engine head when said rotor rotates in a first direction to prevent gas flow communication between said engine cylinder and said conduit." Applicant has been unable to find the foregoing limitations in any of the identified references. Thus, Applicant submits that claim 23 is allowable.

XII. NEW CLAIMS 24, 25

New independent claim 24 recites a valve assembly having a valve "configured to move said valve head toward a valve seat of said engine when said rotor rotates in a first direction, said valve head movement being stopped upon an indication that said valve head has seated against said valve seat. Applicant has been unable to find the foregoing limitations in any of the identified references. Thus, Applicant submits that claim 24 and claim 25 (which depends from claim 24) are allowable.

XIII. NEW CLAIMS 26,27,28,29

New independent claim 26 recites an internal combustion engine having a "camless valve assembly having a valve communicating with said engine cylinder, said assembly adjusting an opening rate of said valve to control gas flow into said engine cylinder." Claim 29 is directed toward adjusting an opening rate of a valve to control gas flow out of an engine cylinder. As discussed above in Section IV, a valve opening rate is an amount of valve lift over a time

period when the valve is being opened. Referring to Figure 7 of the present invention, exemplary valve opening rates are shown such as first opening rate OR1 and a different and faster opening rate OR2, for example.

Referring to Bonvallet, a variable valve lift electromagnetic actuator is disclosed. The reference purports to adjust valve lift, duration, and timing. See Bonvallet, column 7, lines 39-42. However, no where in Bonvallet is there any teaching of adjusting a valve opening rate, as recited in new claims 26, 29. Further, none of the other references cited by the Examiner teach these limitations. Thus, Applicant submits that claim 26, claims 27, 28 (which depend from claim 26), and claim 29 are allowable.

XIV. NEW CLAIMS 30, 31, 32

New independent claim 31 recites an internal combustion engine having a "camless valve assembly having a valve communicating with said engine cylinder, said assembly adjusting a closing rate of said valve to control gas flow into said engine cylinder." Claim 32 is directed toward adjusting a closing rate of a valve to control gas flow out of an engine cylinder. As discussed above in Section IV, a valve closing rate is an amount of valve lift over a time period when the valve is being closed. Referring to Figure 7 of the present invention, exemplary valve closing rates are shown such as a first closing rate CR1 and a different and a slower closing rate CR2, for example.

Referring to Bonvallet, no where in the reference is there any teaching of adjusting a valve closing rate, as recited in new claims 31, 32. Further, none of the other references cited by the Examiner teach these limitations. Thus, Applicant submits that claims 31, 32 are allowable. Further, Applicants submit that new claim 30 which recites an engine having a camless valve assembly that controls both a closing rate and opening rate of a valve is also allowable.

XV. NEW CLAIMS 33, 34

New independent claim 33 recites a control system for an electromechanical valve assembly that has a controller that generates "a commanded valve position signal to adjust an opening rate of said valve to control gas flow communication between said line an said engine cylinder." New claim 34 recites similar limitations except that a controller generates a signal to control a closing rate of the valve. As discussed above, none of the references cited by the Examiner teach these limitations. Accordingly, Applicant submits that claims 33, 34 are allowable.

XVI. NEW CLAIM 35

New independent claim 35 recites a method for controlling a valve assembly that includes "rotating said ballnut to move a valve head against a valve seat of said engine; and, stopping said rotation of said ballnut upon an indication that said valve head has contacted said valve seat to prevent gas flow into or out of an engine cylinder." None of the references cited by the Examiner teach these limitations. Thus, Applicant submits that claim 35 is allowable.

XVII. NEW CLAIM 36

New independent claim 36 recites a method for controlling a camless valve assembly in an engine. The method includes "opening said valve of said camless valve assembly at a first opening rate to control gas flow into said cylinder during a first combustion cycle of said cylinder; and, opening said valve of said camless valve assembly at a second opening rate to control gas flow into said cylinder during a second combustion cycle of said cylinder." None of the references cited by the Examiner teach these limitations. Thus, Applicant submits that claim 36 is also allowable.

XVIII. CONCLUSION

For the above-cited reasons, all the claims presently pending in this application are believed to be allowable. If the Examiner has any further questions or concerning regarding this matter, he is invited to call the Applicant's under signed attorney.

Respectfully submitted,

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ATTACHMENT

Claims 1, 13, 14, 17 are amended as follows:

1. (Amended) An electromechanical valve assembly for an internal combustion engine, said engine having an engine cylinder, said assembly comprising:

a rotor centered about a first axis having a bore extending generally axially therethrough;

a stator operatively disposed about said rotor for producing a torque to cause rotation of said rotor about said first axis; and,

a valve having a valve stem and a valve head, said valve stem [extending generally axially through said bore of said rotor, said valve configured to move generally axially responsive to the rotation of said rotor to selectively engage and disengage said valve head with a valve seat of said engine] configured to move upwardly when said rotor rotates in a first direction to move said valve head against a valve seat in said engine to prevent gas flow into or out of said engine cylinder.

13. (Amended) An electromechanical valve assembly for an internal combustion engine, comprising:

a rotor centered about a first axis having a bore extending generally axially therethrough, said rotor having a first helical groove;

a stator operatively disposed about said rotor for producing a torque to cause rotation of said rotor about said first axis, said stator being formed of a plurality of laminated plates;

a valve having a valve stem and a valve head, said valve stem extending generally axially through said bore of said rotor, said valve stem having a second helical groove, said first and second helical grooves forming a raceway between said rotor and said valve stem for holding ball bearings therein and,

a plurality of ball bearings disposed within said raceway wherein said valve moves axially responsive to rotation of said rotor <u>to move said valve head against a valve seat in said engine to prevent gas flow into or out of an engine cylinder</u>.

14. (Amended) An electromechanical valve assembly for an internal combustion engine, comprising:

a rotary electric actuator having a rotatable ballnut; and,

a valve having a valve stem and a valve head, said valve stem operatively connected to said ballnut, said valve stem configured to move generally axially responsive to the rotation of said ballnut to selectively engage and disengage said valve head with a valve seat <u>on a cylinder head</u> of said engine.

17. (Amended) A control system for a linear actuated electromechanical valve assembly, said valve assembly including a valve controlling fluid communication through a line connected with a cylinder of [displaceable pressure boundary] an internal combustion engine, said control system comprising:

a valve controller for generating a commanded valve position current to control the incremental axial position of said valve; and,

a position sensor generating a signal responsive to an axial position of said valve, and wherein said valve controller can vary an opening rate and a closing rate [a valve operational parameter] of said valve [independent of displacement of said engine pressure boundary].